

## **FLAKINESS INDEX OF COARSE AGGREGATE**

(An Arizona Method)

### **SCOPE**

1. (a) This test method describes the procedure for determining the "Flakiness Index" (flatness) of coarse [Plus 2.36 mm (No. 8) aggregate]. The Flakiness Index is the percentage of particles having a least dimension smaller than 60 percent of the mean size of each of one or more of the coarse sieve fractions. The lower the index for any sample of aggregate, the more nearly the aggregate particles approximate a cubical shape.

(b) Once the Flakiness Index is known, the average least dimension of the aggregate can be determined if required, for example as in Arizona Test Method 819, "Design of Exposed Aggregate Seal Coats". The procedure for determining the average least dimension of the aggregate is described in Section 6 of this test method.

(c) This test method may involve hazardous material, operations, or equipment. This test method does not purport to address all of the safety concerns associated with its use. It is the responsibility of the user to consult and establish appropriate safety and health practices and determine the applicability of any regulatory limitations prior to use.

(d) See Appendix A1 of the Materials Testing Manual for information regarding the procedure to be used for rounding numbers to the required degree of accuracy.

(e) Metric (SI) units and values are shown in this test method with English units and values following in parentheses. Values given for metric and English units may be numerically equivalent (soft converted) for the associated units, or they may be given as rounded or rationalized values (hard converted). Either the metric or English units along with their corresponding values shall be used in accordance with applicable specifications. See Appendix A2 of the Materials Testing Manual for additional information on the metric system.

## APPARATUS

2. Requirements for the frequency of equipment calibration and verification are found in Appendix A3 of the Materials Testing Manual. Apparatus for this test procedure shall consist of the following:

(a) For each size of material to be tested, a 16 gauge steel plate [1.6 mm (1/16 inch) nominal thickness] with a slotted opening approximately 100 mm (4 inches) in length and having a width conforming to the applicable requirements given below. If desired, the same plate may contain all or some of the required slots, rather than a separate plate for each.

Size of Material		Slot Width (millimeters)	Slot Width Tolerance (mm)
Passing	Retained		
37.5 mm	25.0 mm	18.8	$\pm 0.6$
25.0 mm	19.0 mm	13.2	$\pm 0.4$
19.0 mm	12.5 mm	9.5	$\pm 0.3$
12.5 mm	9.5 mm	6.6	$\pm 0.2$
9.5 mm	6.3 mm	4.7	$\pm 0.1$
6.3 mm	4.75 mm	3.3	$\pm 0.1$
4.75 mm	2.36 mm	2.1	$\pm 0.1$

Size of Material		Slot Width (inches)	Slot Width Tolerance (inches)
Passing	Retained		
1-1/2"	1"	0.738	$\pm 0.023$
1"	3/4"	0.520	$\pm 0.016$
3/4"	1/2"	0.372	$\pm 0.012$
1/2"	3/8"	0.260	$\pm 0.008$
3/8"	1/4"	0.187	$\pm 0.006$
1/4"	No. 4	0.131	$\pm 0.004$
No. 4	No. 8	0.084	$\pm 0.003$

(b) A balance or scale capable of measuring the maximum weight to be determined and conforming to the requirements of AASHTO M 231, except the readability and sensitivity of any balance or scale utilized shall be at least one gram.

(c) Sieves conforming to the requirements of AASHTO M 92, of sizes 37.5 mm (1-1/2"), 25.0 mm (1"), 19.0 mm (3/4"), 12.5 mm (1/2"), 9.5 mm (3/8"), 6.3 mm (1/4"), 4.75 mm (No. 4), and 2.36 mm (No. 8), as necessary for the material being tested.

## **SAMPLE PREPARATION**

3. (a) A representative sample of the aggregate for the specified use shall be obtained. The size of sample shall be at least the size required by Arizona Test Method 201, and larger if necessary to provide adequate material for the applicable required individual size fractions indicated below. (See paragraph (c) below for determination of the individual size fractions to be tested.)

Size of Material		Minimum Test Sample (grams)
Passing	Retained	
37.5 mm (1-1/2")	25.0 mm (1")	3000
25.0 mm (1")	19.0 mm (3/4")	1500
19.0 mm (3/4")	12.5 mm (1/2")	1000
12.5 mm (1/2")	9.5 mm (3/8")	500
9.5 mm (3/8")	6.3 mm (1/4")	200
6.3 mm (1/4")	4.75 mm (No. 4)	100
4.75 mm (No. 4)	2.36 mm (No. 8)	50

(b) The sample shall be subjected to sieve analysis in accordance with Arizona Test Method 201. If both the coarse and fine sieve analysis of the material are performed, material passing the 4.75 mm (No. 4) sieve shall be separated into 2.36 mm (No. 8) and passing 2.36 mm (No. 8) fractions by sieving over a 2.36 mm (No. 8) sieve. Reference can also be made to Section 3 of Arizona Test Method 248 for utilizing a 2.36 mm (No. 8) sieve in the coarse sieving, and a fine sieve analysis not being required. The coarse aggregate size fractions of 2.36 mm (No. 8) and larger shall be placed in individual containers. The material passing the 2.36 mm (No. 8) sieve may be discarded.

(c) From each size fraction that has a percent retained value from sieve analysis which is equal to or greater than 10%, obtain a representative test sample of the weight specified in paragraph (a) above.

## **FLAKINESS INDEX TEST PROCEDURE**

4. (a) Weigh each test sample to the nearest gram and record as the "Weight of Test Sample", for the respective size fraction.

(b) The particles from the test sample for each size fraction shall be individually tested for their ability to pass through the appropriate slot, as specified in paragraph 2(a). Weigh the material which passes the appropriate slot, and record to the nearest gram as the "Weight Passing Slot", for the respective size fraction.

## **CALCULATIONS FOR FLAKINESS INDEX DETERMINATION**

5. (a) Figure 1 is a blank Flakiness Index form which contains the required calculations. An example is given in Figure 2.

(b) Calculate the "Percent Passing Slot", for each respective size fraction, and record to the nearest percent.

(c) Calculate the "Flakiness Index", and report the result to the nearest percent.

## **DETERMINATION OF AVERAGE LEAST DIMENSION OF AGGREGATE**

6. When it is required (such as in Arizona Test Method 819), the average least dimension of the aggregate may be determined by using Figures 3 and 4. (These figures include an example which illustrates the procedure described in the paragraphs below.)

(a) The median size of the aggregate is determined as shown in the example in Figure 3. Plot the % passing from sieve analysis for the two sieve sizes sufficient to locate the 50% line intercept. Draw a line between the two points. From the 50% passing point on the right side of the chart, proceed horizontally to the left until the line drawn between the two points is intercepted. Draw a line vertically from this point to intercept the "Median Size" scale at the bottom of the chart. Read the resultant median size to the nearest 0.25 mm (0.01 inch).

(b) The average least dimension of the aggregate is determined as shown in the example in Figure 4. Find the point for "Median Size" on the left side of the chart. Proceed horizontally to the right until the corresponding line for Flakiness Index is intercepted. Draw a line vertically from this point to intercept the "AVERAGE LEAST DIMENSION" at the bottom of the chart. Read and record the average least dimension of the aggregate to the nearest 0.25 mm (0.01 inch).

# FLAKINESS INDEX CALCULATIONS

(ARIZONA TEST METHOD 233)

Project No. \_\_\_\_\_ Lab No. \_\_\_\_\_ Material \_\_\_\_\_

Sieve Size	37.5 mm (1-1/2")	25.0 mm (1")	19.0 mm (3/4")	12.5 mm (1/2")	9.5 mm (3/8")	6.3 mm (1/4")	4.75 mm (#4)	2.36 mm (#8)
% Pass from Sieve Analysis								
% Ret. from Sieve Analysis (F)								
Weight of Test Sample								
Weight Passing Slot								
* Percent Passing Slot (P)								
NOTE: Only the size fractions which have 10 or more percent retained are tested for passing the appropriate slot, and used to determine the Flakiness Index by the equation below.	$* \text{ Percent Passing Slot (P)} = \frac{\text{Weight Passing Slot}}{\text{Weight of Test Sample}} \times 100$							

$$\text{FLAKINESS INDEX} = \frac{\{F [37.5 \text{ mm (1-1/2")}] \times P [37.5 \text{ mm (1-1/2")}] \} + \dots + \{F [2.36 \text{ mm (No. 8)}] \times P [2.36 \text{ mm (No. 8)}]\}}{\{F [37.5 \text{ mm (1-1/2")}] + \dots + F [2.36 \text{ mm (No. 8)}]\}}$$

FLAKINESS INDEX = \_\_\_\_\_ = %

Remarks:

---



---



---



---

Test Operator and Date: \_\_\_\_\_ Supervisor and Date: \_\_\_\_\_

FLAKINESS INDEX CALCULATIONS

(ARIZONA TEST METHOD 233)

Project No. F-099-9(9) H099901C Lab No. 96-524 Material COVER MATERIAL

Sieve Size	37.5 mm (1-1/2")	25.0 mm (1")	19.0 mm (3/4")	12.5 mm (1/2")	9.5 mm (3/8")	6.3 mm (1/4")	4.75 mm (#4)	2.36 mm (#8)
% Pass from Sieve Analysis				100	78	27	13	2
% Ret. from Sieve Analysis (F)				0	22	51	14	11
Weight of Test Sample				-	611	263	139	78
Weight Passing Slot				-	104	71	28	19
* Percent Passing Slot (P)				-	17	27	20	24
NOTE: Only the size fractions which have 10 or more percent retained are tested for passing the appropriate slot, and used to determine the Flakiness Index by the equation below. <div style="text-align: right;">             * Percent Passing Slot (P) = <math>\frac{\text{Weight Passing Slot}}{\text{Weight of Test Sample}} \times 100</math> </div>								

$$\text{FLAKINESS INDEX} = \frac{\{F [37.5 \text{ mm } (1-1/2'')] \times P [37.5 \text{ mm } (1-1/2'')]\} + \dots + \{F [2.36 \text{ mm (No. 8)}] \times P [2.36 \text{ mm (No. 8)}]\}}{\{F [37.5 \text{ mm } (1-1/2'')] \} + \dots + F [2.36 \text{ mm (No. 8)}]}$$

$$\text{FLAKINESS INDEX} = \frac{(22 \times 17) + (51 \times 27) + (14 \times 20) + (11 \times 24)}{22 + 51 + 14 + 11} = 23 \%$$

Remarks:

---



---



---

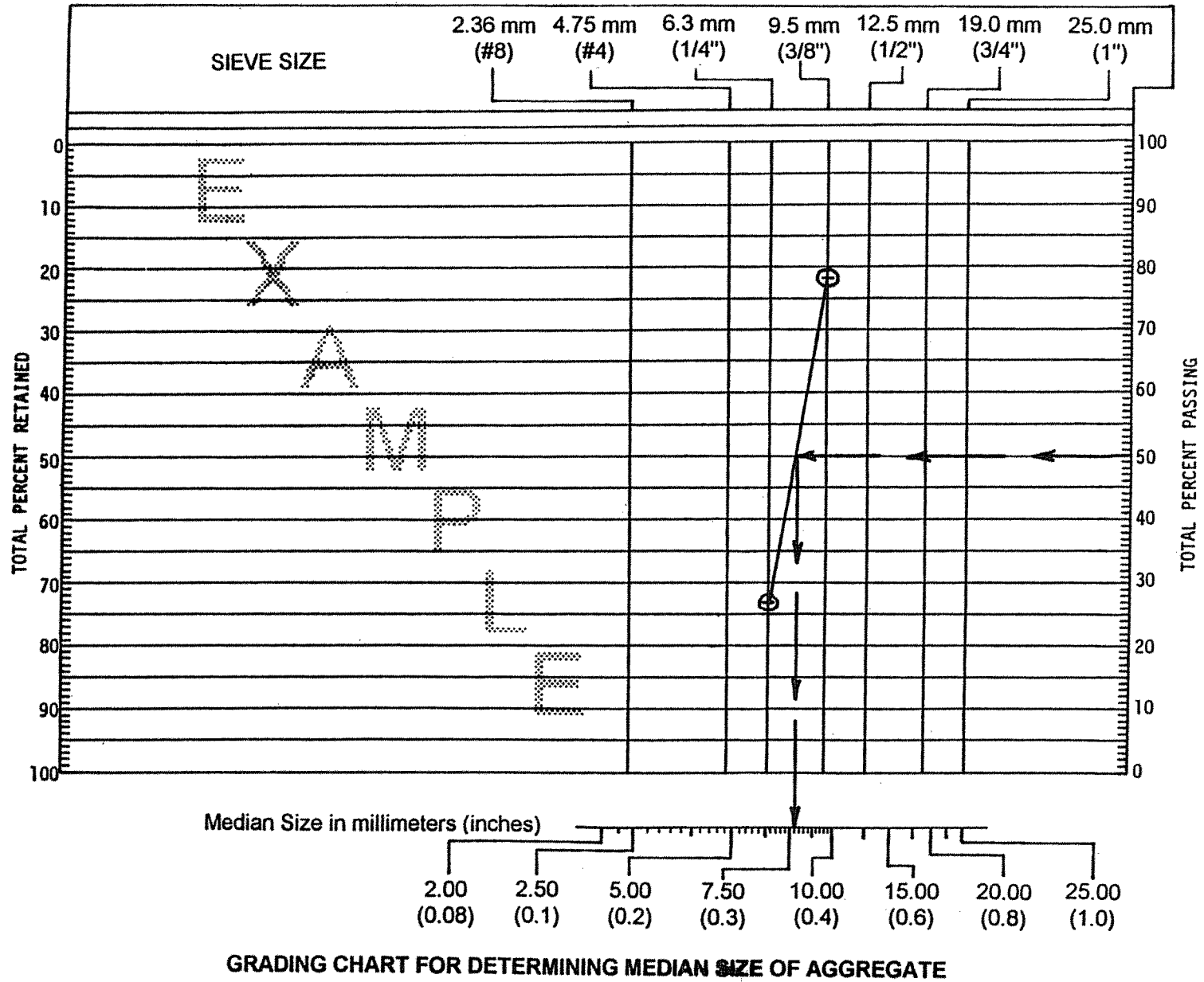


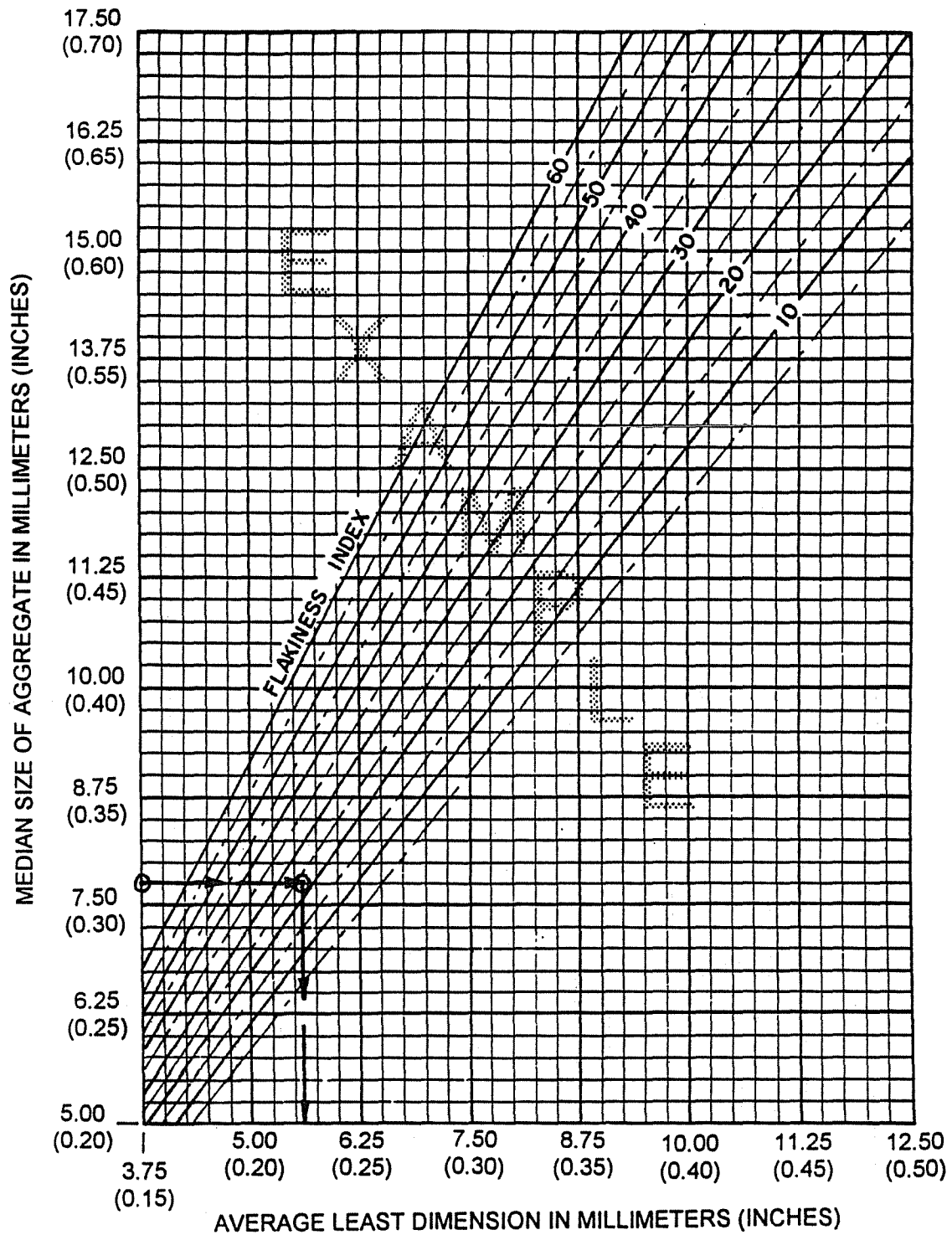
---

Test Operator and Date: Joe Tester 11-20-96 Supervisor and Date: Pete Headman 11-20-96

FIGURE 2

FIGURE 3





DETERMINATION OF AVERAGE LEAST DIMENSION OF AGGREGATE

FIGURE 4